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Wheat Varieties for Wyoming

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UNIVERSITY OF WYOMING
AGRICULTURAL EXPERIMENT STATION
LARAMIE, WYOMING

Cover Page Picture: Spring wheat varieties grown at the Wyoming Experiment Station, Laramie. Varieties, left to right, are: Ceres, Pilot, and Mida. Note slight lodging in Ceres and Pilot.

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WHEAT VARIETIES FOR WYOMING

DAYTON L. KLINGMAN[1]

Wheat is the most important grain crop produced in Wyoming, based on average annual crop value figures for the 10-year period from 1934 to 1943, taken from Agricultural Statistics (8)[2] (Fig. 1). During that period wheat was valued at $2,414,830 annually, of which value winter wheat made up $1,296,880 and spring wheat $1,117,950. Two other Wyoming crops exceeded wheat in annual value during this period, alfalfa ($5,047,952) and sugar beets ($2,990,000).

Increased efficiency in wheat production may be obtained through: improved cultural and seeding practices; care of the crop; better crop rotations; and use of improved varieties. The cultural practices for Wyoming have been covered in some detail by Hartman (4). This bulletin will be limited largely to a discussion of varieties.

SPRING WHEAT VARIETIES

There is a great need for educational emphasis upon the use of improved varieties of spring wheat. A survey made by the U. S. Department of Agriculture of wheat varieties grown in Wyoming (Fig. 2) shows Marquis wheat leading all other spring wheat varieties in acres grown in 1944. Marquis, with almost 40,000 acres, was closely followed by Ceres, 35,000 acres, while Thatcher had an acreage of but 2,500 acres. There has been, however, some increase in Thatcher acreage since that time because of the stem-rust injury to susceptible varieties. Thatcher has been resistant to the stem-rust races prevalent in Wyoming. There has also been some increase in Pilot, which was first recommended in Wyoming in 1944. The need for replacing Marquis and Ceres with the superior varieties now available is apparent from a study of Fig. 3. The yield data obtained under irrigated conditions in Wyoming (a total of 17 separate tests conducted by the Wyoming Agricultural Experiment Station at Laramie, Torrington, and Afton and in the Big Horn Basin) show that Marquis is outyielded 6.5 and 8.4 bushels per acre by Thatcher and Pilot, respectively. Both Thatcher and Pilot have also been substantially

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2. Numbers in parentheses refer to literature cited.

superior in yield to Marquis in the dry-land tests (a total of 21 separate tests by the Wyoming Experiment Station at Sheridan, Gillette, and Archer). Both have outyielded Marquis by 3.2 bushels per acre in these tests and exceeded Ceres by 0.6 bushels per acre. In all comparative tests which have run for several years duration, Thatcher and Pilot have both outyielded Marquis. It is obvious that a change in varieties is needed and will result in greater returns to spring wheat growers of the state.

RECOMMENDED VARIETIES

Thatcher (C. I. No. 10,003)[1] is a hard red spring wheat resistant to stem-rust, is beardless, and has a relatively early maturity. It possesses short stiff straw (2), a quality which is important under irrigated conditions where lodging is often a problem. This wheat has had an excellent yield record in Wyoming, being almost equal in yield to Pilot when irrigated and equal to Pilot when all dry-land tests are averaged together. As can be seen in Table I, Thatcher has equalled or exceeded all named varieties in the advanced tests at Laramie. It also has excelled in weight per bushel (Table 2). Thatcher was four days earlier heading than Marquis and averaged three inches shorter in height. It is, however, susceptible to leaf rust. At the Sheridan Field station, Thatcher has been grown for 13 years under dry-land conditions and in that period was exceeded in yield only by Comet. The variety has an average yield advantage of 4.2 bushels per acre over Marquis and a 0.6 bushel advantage over Ceres during the 13 years (Table 3). In agronomic characteristics at the Sheridan station (Table 4), Thatcher is four days earlier heading than Marquis, three days earlier ripening, and three inches shorter. It is equal to Marquis in test weight per bushel. At other locations in the state (Table 5), it has been tested for a shorter period of time. In all of these tests the average yields of Thatcher have exceeded those of Marquis. In addition to the higher yields, Thatcher is a grain of excellent milling and baking quality, although the grain of Marquis is brighter in color.

When Thatcher and Marquis are grown together, the casual observer might conclude that Marquis would be the superior yielding variety because of its height and slightly longer heads. The yield results from the extensive trials enumerated above, however, refute any such assumption.

1. C. I. No. refers to United States Department of Agriculture accession numbers.

According to Dr. J. Allen Clark (2), "the development of Thatcher wheat extends over a long period, starting with the introduction from Italy in 1901 of Iumillo durum wheat, followed by the discovery of the resistance of Iumillo to stem-rust in 1904. Iumillo was first crossed with Marquis in 1914, and a selection from the resulting hybrid was crossed in 1921

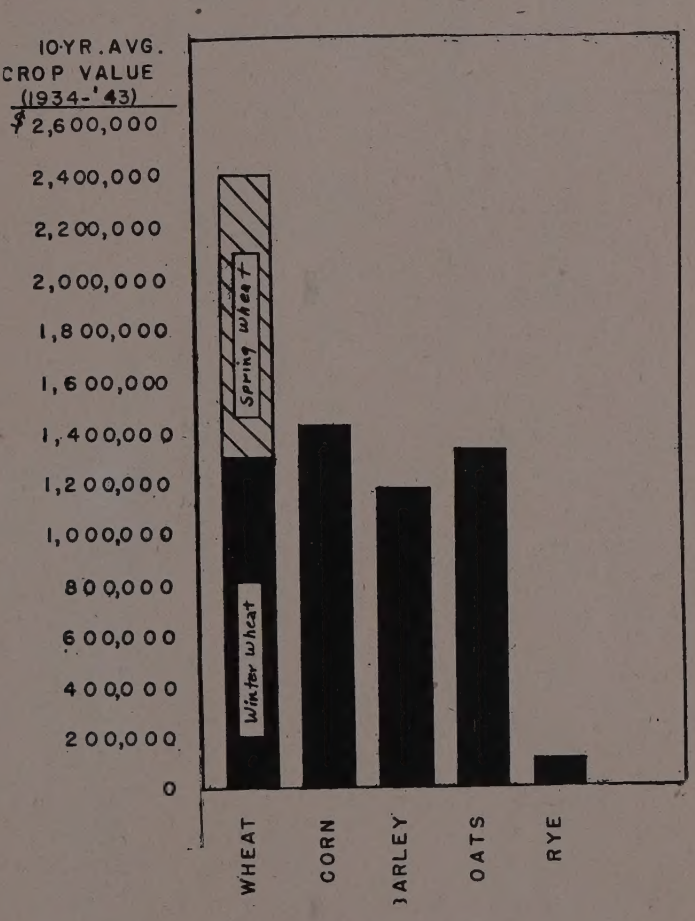

Fig. 1. Relative average annual value of the grain crops produced in Wyoming in the 10-year period from 1934 to 1943. Taken from *Agricultural Statistics*, U.S.D.A., for 1946.

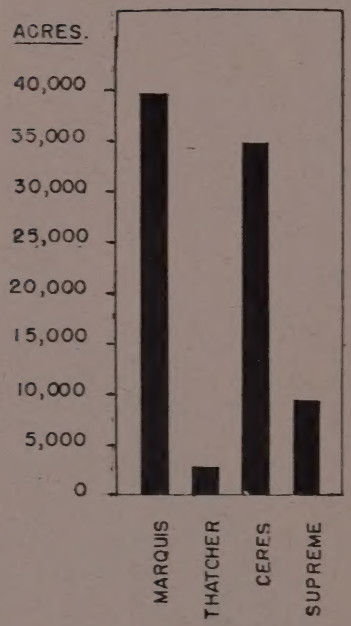

Fig. 2. Relative acreage of spring wheat varieties grown in Wyoming in 1944.

with a selection from a hybrid between Marquis and the winter wheat Kanred. The final selection from the 1921 cross, which resulted in Thatcher, was made in 1925. It was first included in field plot experiments in 1929 and first distributed and recommended for growing in Minnesota in 1934. After the rust epidemic of 1935, it spread rapidly into the eastern Dakotas and Manitoba, where stem-rust had caused severe crop losses.

"In some sections Thatcher is too short for convenient harvesting; also many farmers prefer a taller wheat and some prefer a bearded type, especially for combining. Other disadvantages of Thatcher wheat are its tendency to have low test weight and to bleach under moist conditions before threshing. It is not so resistant to bunt or stinking smut as is desired, being susceptible to certain races."

Pilot (C. I. 11,945) is a bearded, high-yielding, hard red spring variety which is resistant to both stem and leaf rusts and to bunt or stinking smut. However, Pilot does not have the strong straw which many farmers want and may lodge when grown under irrigation or under other conditions which encourage heavy growth. For this reason Pilot is recommended primarily for dry-land conditions in Wyoming, although it has an excellent yield record in irrigated tests (Fig. 3, Table 1, and Table 5). Pilot has outyielded Ceres by an average of 5.7 bushels per acre in the 17 irrigated tests and has an average advantage of 0.6 bushel in the 21 dry-land tests. In addition to yield advantage, Pilot has bunt resistance (Ceres is susceptible) and an average stem-rust reading of zero at Laramie (Table 2), compared to a stem-rust reading of 38 per cent for Ceres. Pilot also has an advantage in leaf rust resistance, showing a 30 per cent

infection compared to 56 per cent for Ceres. Pilot headed at the same date as Ceres at Laramie and averaged one day earlier at Sheridan. In height, Pilot averaged eight inches shorter than Ceres at Laramie (38 to

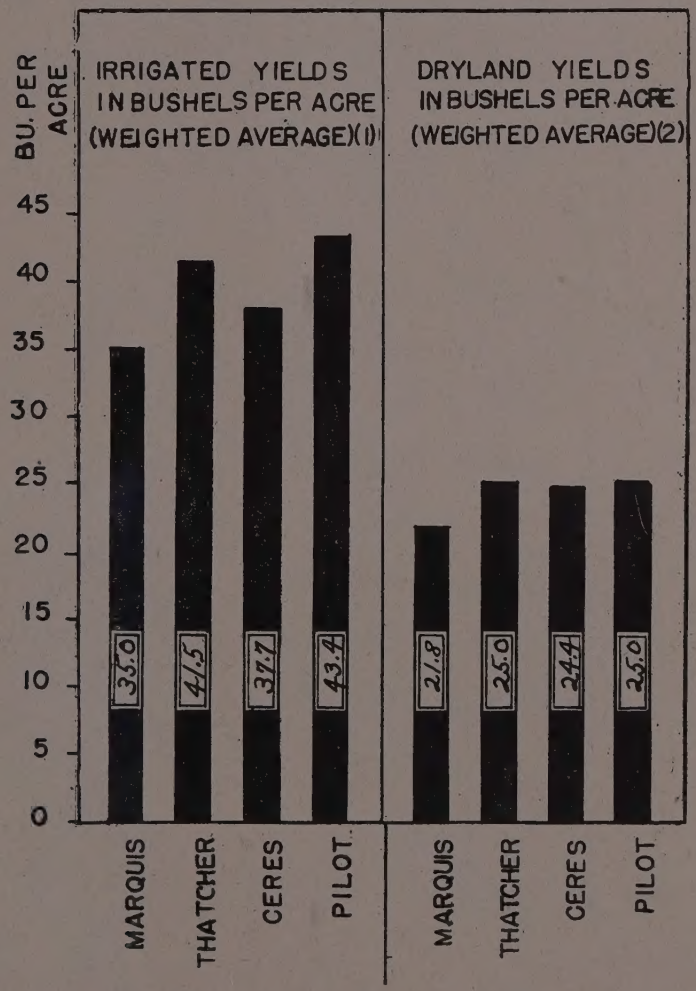

Fig. 3. Average yields of spring wheat varieties grown in Wyoming:
(1) Weighted as follows: Laramie 6 yrs.; Torrington 4 yrs.; Big Horn Basin 4 yrs.; Afton 3 yrs.; or 17 station-years.
(2) Weighted as follows: Sheridan Station 12 yrs.; Gillette 5 yrs.; Archer 4 yrs.; or a total of 21 station-years.

Table 1. YIELD DATA OF THE SPRING WHEAT VARIETIES GROWN IN ADVANCED TEST PLOTS FOR 1940-47 AT THE AGRICULTURAL EXPERIMENT STATION, LARAMIE, WYOMING

Variety	C.I. No. (a)	Yields in bushels per acre.									Percent of Thatcher for yrs. grown (Thatcher=100%) (b)	Number of yrs.
		1940	1941	1942	1943	1945	1946	1947	6 yr. av. 1941-47	5 yr. av. 1942-47		
Marquis	3,641	38.5	56.9	50.6	35.5	32.6	52.2	27.9	42.6	39.8	77.6	7
Thatcher	10,003	45.3	66.6	47.3	41.0	48.8	70.4	59.8	55.7	53.4	100.0	7
Reliance	7,370	48.9	69.1	53.2	48.6						109.8	4
Hard Federation (white wheat)	4,980	34.6	55.1	48.8								
Pilot	11,945		70.5	55.4	42.8	50.3	62.1	53.4	55.8	52.8	87.0	3
Comet	11,465		69.4	53.7	42.5	36.3	60.1				100.2	6
Ceres	6,900		64.9	51.3	41.6	40.1	58.8	28.2	47.5	44.0	95.6	5
Kubanka (Durum)	1,440		64.1	49.9							85.2	6
Rival	11,708		60.8	40.8	35.8						100.1	2
Cadet	12,053			45.2	45.2	48.4	62.8	62.7		52.8	84.6	3
Onas	6,221			64.9	47.3	31.1	52.0	14.2		41.9	98.9	5
Hope x Thatcher[3]	12,199			53.0	49.8	57.1	75.2	68.0[c]		60.6	78.5	5
Pilot x Mida	12,303					57.3	58.3	64.8			113.5	5
Mida	12,008					52.6	53.8	70.3			100.8	3
Merit x Pilot	12,315					46.3	57.3	71.3			98.7	3
Newthatch	12,318					48.7		60.5			97.7	3
Mida x N1315	12,629							76.4			100.5	2
1590 x Thatcher	12,630							71.1			127.7	1
											118.9	1
Least difference for significance (d)		8.2	7.4	7.4	6.0	3.2	6.2	6.8	2.6	2.7		

(a) Refers to United States Department of Agriculture accession numbers.
(b) Per cent of Thatcher yields for years grown.
(c) Yield data for C.I. No. 12,044 used in 1947.
(d) A difference exceeding that shown could occur by chance alone only once in 20 trials.

Table 2. AGRONOMIC NOTES AND DISEASE REACTION ON SPRING WHEAT VARIETIES GROWN IN THE ADVANCED TEST PLOTS, LARAMIE, WYOMING

Variety	C. I. No.	Av. Wt. Per Bu.	Av. Date Headed	Av. Height	% Lodging	% Shattering	% Stem Rust	% Leaf Rust
		1942-47	1942-47 (July)	1942-47 (Inches)	1946-47	1943-46	1942-47	1942-47
Marquis	3,641	58	18	41	37	2	45.0	60
Thatcher	10,003	61	14	37	39	1	0.5	67
Pilot	11,945	60	15	37	38	1	0.0	30
Comet (a)	11,465	60	10	34	2	1	60.0	87
Ceres	6,900	58	15	40	46	1	38.0	56
Cadet	12,054	59	17	41	29	2	0.01	32
Onas	6,221	49	15	35	38	1	77.0	75
Hope x Thatcher[3] (b)	12,199	61	14	38	9	1	0.4	35
Mida (c)	12,008	60	14	41	11	.9	0.05	29

(a) Four year average, no 1947 data available.

(b) Data for Newthatch used in 1947.

(c) Not grown in 1942. Data from nearby nursery used for 1943.

Table 3. YIELD DATA FOR VARIETIES OF SPRING WHEAT GROWN AT THE SHERIDAN FIELD STATION (DRY-LAND STATION). YIELDS ARE IN BUSHELS PER ACRE.

Variety	C. I. No.	Yields in bushels per acre													13-yr. Av.	12-yr. Av.	5-yr. Av.
		1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	35-47	36-47	43-47
Thatcher	10,003	8.9	3.4	20.2	41.9	38.5	24.8	28.4	22.9	38.8	13.6	31.5	47.7	41.0	27.8	29.4	34.5
Marquis	3,641	5.8	2.8	13.1	34.8	31.2	22.6	23.5	22.0	31.5	14.7	31.4	40.9	33.0	23.6	25.1	30.3
Ceres	6,900	11.9	3.7	22.3	39.1	35.7	24.2	24.4	25.7	36.7	23.0	32.0	43.1	31.2	27.1	28.4	33.2
Comet	11,465	11.6	3.8	19.5	44.9	39.4	27.8	30.0	21.8	36.4	15.2	36.7	42.5	35.4	28.1	29.4	33.3
Pilot	11,945 (a)		2.4	19.6	37.3	33.6	23.2	27.2	24.4	40.7	19.6	37.3	43.7	39.9		29.1	36.2
Reward	8,182	12.5	4.0	22.6	32.1	30.6	21.7	27.2	28.5								
Komar	8,004	11.6	5.8	21.1	40.0	28.1											
Reliance	7,370	7.6	1.2	15.9	40.7	27.5											
Supreme	8,025	8.6	2.4	13.8													
Hope	8,187	7.9	1.8	16.2													
Kubanka (Durum)	1,440	6.1	2.1	17.1	34.2	23.2											
Mida	12,008						24.1	26.9	27.2	39.7	13.1	32.7	48.3	37.4			34.2
Cadet	12,053							21.4	19.0	39.1	14.1	23.2	48.0	35.0			31.9
Newthatch	12,318									29.9	13.1	29.3	39.1	33.6			29.0
Merit x Pilot	12,315										19.6	36.2	51.4	37.3			
Pilot x Mida	12,303										21.4	31.7	49.5	38.5			
Mida x Cadet	12,363										14.7	37.1	46.8	38.2			
Comet x Pilot	12,073							28.7	30.3	41.9	16.5	37.2	44.3				

(a) 1936-1939, C. I. 11,428 yield data used.

Table 4. AGRONOMIC DATA ON SPRING WHEAT VARIETIES GROWN AT THE SHERIDAN FIELD STATION

Variety	C. I. No.	Average for 1943 to 1946			
		Av. Date Headed	Av. Date Ripe (Aug.)	Av. Ht. (Inches)	Av. Wt. Per Bu. (lbs.)
Thatcher	10,003	June 30	5	41	58
Marquis	3,641	July 3	8	44	58
Ceres	6,900	July 3	7	45	58
Comet	11,465	June 30	6	40	58
Pilot	11,945	July 2	6	43	58
Mida	12,008	July 1	7	46	59
Cadet	12,053	July 3	7	44	56
Newthatch	12,318	July 1	5	40	56
Merit x Pilot	12,315	June 30 (a)	6 (b)	44 (c)	56 (d)
Pilot x Mida	12,303	July 1 (a)	7 (b)	46 (c)	59 (d)
Mida x Cadet	12,363	July 2 (a)	8 (b)	46 (c)	58 (d)

(a) 1944-46 average, Thatcher headed June 30 in the same period.

(b) 1944-46 average, Thatcher ripened Aug. 5 in the same period.

(c) 1944-46 average, Thatcher height was 44 inches in the same period.

(d) 1944-46 average, Thatcher weight was 58 pounds per bu. for the same period.

46 inches) and two inches shorter at Sheridan (Table 4). In the dry-land trials which have been grown for five and four year periods at Gillette and Archer respectively, Pilot and Ceres were equal in yield at Gillette, and Pilot had a slight advantage at Archer.

Pilot was developed cooperatively by the Division of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture and the North Dakota and other state agricultural experiment stations. According to Clark and Bayles (3), "It is the result of a cross between Hope and Ceres made at Mandan, N. Dak. in 1926." The selection was made in F_3* in 1928. Reselections were made in 1933 at Langdon, N. Dak. Eighty of the 100 head selections grown in 1934 were composited for increase as N. No. 1098A**. Nine of the high-yielding selections grown during the rust epidemic of 1935 were composited for increase as N. No. 1098B. It was registered as an improved variety in 1938." Selection N. No. 1098-13 (called Pilot-13, C. I. No. 11,945), which is pure for resistance to leaf rust and mildew, was increased for distribution to replace the earlier increases which were not pure for resistance to these two diseases. Pilot (as it is now called) is a wheat with excellent milling and baking qualities.

* F_3 (third filial generation). Seed resulting from the original cross is F_1, the second generation removed from parents is F_2, third is F_3, etc.

** N. No. refers to the U. S. Department of Agriculture nursery numbers.

Fig. 4. Spring wheat varieties grown at the Wyoming Experiment Station, Laramie. Varieties, left to right, are: Newthatch, Thatcher, and Mida x Cadet (C.I. 12,363).

Fig. 5. Spring wheat varieties grown at the Wyoming Experiment Station, Laramie. Varieties, left to right are: Marquis, Cadet, and Ceres.

Onas (C. I. 6,221) is a soft white wheat recommended to those growers of wheat for feed where stem-rust is not a factor in production. When rust free, it is most productive under irrigated conditions in Wyoming. It has a short stiff straw and is a beardless wheat. Onas seed should always be treated to prevent bunt, since the variety is quite susceptible to this disease.

The yield record for Onas at Laramie is not outstanding since in each of the five years grown it has had stem-rust readings ranging from 40 to 100 per cent infection, with an average of 77 per cent (Table 2). Rust was also a factor in the tests at Torrington. However, the tests in the Big Horn Basin show Onas to advantage in the absence of rust (Table 5). The susceptible varieties at Powell in 1944 were damaged somewhat by stem-rust. Onas has headed one day later than Thatcher and averaged two inches shorter at Laramie (Table 2).

According to Clark and Bayles (3), Onas was developed by F. Coleman of Tuela, Saddleworth, South Australia, from a cross between Federation and Tarragon, the latter in turn from a cross between Improved Fife and Tarden's Blue. Onas was introduced from Australia by the U. S. Department of Agriculture in 1918. After the variety had been tested in cooperative experiments in the Pacific coast states, seed was distributed from University Farm at Davis, California in 1923. It was registered as an improved variety in 1926, its superior characters being high yielding capacity and strong stems.

Table 5. YIELDS OF VARIETIES OF SPRING WHEAT RAISED COOPERATIVELY IN WYOMING
(Yields are given in bushels per acre.)

Variety	C. I. No.	Gillette Substation					Archer Substation			
		1943	1944	1945	1946	1947	1944	1945	1946	1947
Comet	11,465	23.7	25.7	29.7	15.9		16.4	20.1	10.8	
Regent	12,070	22.0	27.3							
Onas (White Wheat)	6,221	22.7		26.9	19.3	22.1		16.5	8.0	20.0
Ceres	6,900	20.7	24.7	26.2	15.7	21.0	18.2	17.1	9.0	20.2
Thatcher	10,003	20.4	26.8	21.0	13.2	18.2	23.9	17.7	8.2	20.6
Pilot	11,945	20.2	26.4	26.5	13.8	21.7	21.8	18.4	8.6	19.3
Reliance	7,370	20.2								
Marquis	3,641	18.8	24.2	22.7	16.2	18.1	14.8	15.3	7.4	18.4
Rival	11,078	18.8	27.6				19.1			
Renown	11,947	19.8	24.2				17.7			
Hope x Thatcher[3]	12,199		26.5	25.3	13.0	19.4	21.8	17.2	8.6	21.6
Newthatch	12,318		27.2	20.5			18.6	15.1		
Reward	8,182						17.3			
Cadet	12,053			22.9	15.6	19.8		16.7	7.6	18.8
Merit x Pilot	12,315			21.9	16.3	21.5		19.1	10.8	18.9
Pilot x Mida	12,303			22.5	16.3	21.5		17.1	8.9	20.1
Mida	12,008			24.5	15.8	20.5		19.4	11.1	20.5
Mida x Cadet	12,363				17.4	21.6			7.5	22.6
Mida x 1315	12,629				15.7	20.5		15.7	10.2	20.1
Least difference for significance (a)			2.8	5.0	4.8	3.9	3.6	1.2	4.2	3.6

(a) A difference exceeding that shown could occur by chance alone only once in twenty times.

Table 5. (Cont.) YIELDS OF VARIETIES OF SPRING WHEAT RAISED COOPERATIVELY IN WYOMING

Variety	C. I. No.	Torrington Substation (Irrigated)				Big Horn Basin (Irrigated)				Afton Substation (Irrigated)		
		1943	1944	1945	1947	Lovell (a) 1943	Cody (b) 1944	Powell (c) 1945	Worland 1947	1944	1945	1946
Comet	11,465	9.7	23.4	23.8		24.4	67.4			37.2	24.9	27.3
Regent	12,070	2.3	33.7			22.7		40.5				
Onas (White Wheat)	6,221	11.0	19.4	21.9	50.9	41.0	85.9	40.6	40.8	37.1	19.5	24.7
Ceres	6,900	11.8	24.2	33.4	51.2	28.3	63.0	41.0	28.2	33.1	18.3	23.4
Thatcher	10,003	12.0	33.3	27.3	56.0	20.9	67.9	42.3	34.8	35.6	17.3	24.7
Pilot	11,945	12.8	36.3	33.6	60.5	27.7	66.7	48.5	37.3	34.6	18.8	25.6
Reliance	7,370	10.5				25.2						
Marquis	3,641	8.6	24.6	27.9	52.5	20.9	62.4	39.5	31.7	30.7	17.6	22.9
Rival	11,708	13.7	33.3			20.9						
Renown	11,947	2.9	40.1			28.3						
Hope x Thatcher[3]	12,199		37.0	27.8	54.7		70.5	51.0	34.6	30.9	12.2	26.5
Newthatch	12,318		31.8	30.0			64.1	44.9		33.0	13.1	
Reward	8,182		29.5				53.4	40.6		26.3		
Baart (White)	1,697		31.0	38.4			64.8	37.8		29.2		
Cadet	12,053		37.4		61.2				38.2		16.4	26.3
Merit x Pilot	12,315			47.2	57.6				35.8		18.4	20.6
Pilot x Mida	12,303			47.2	57.0				36.5		19.2	28.2
Mida	12,008			43.6	52.1				32.5		15.5	22.5
Mida x Cadet	12,363				61.9				39.2			26.5
Mida x 1315	12,629				51.5				38.2			27.7
Least difference for significance (d)		1.9	6.8	5.4	9.4	9.0	6.2	8.5	9.8		4.2	9.0

(a) Grown under the supervision of Mr. D. Pence, Voc. Agri. Instructor.
(b) J. Legg farm west of Cody cooperatively with J. M. Nicholls, Co. Agri. Agent.
(c) R. A. Allen farm north of Powell cooperatively with J. M. Nicholls, Co. Agri. Agent.
(d) A difference exceeding that shown could occur by chance alone, only once in twenty trials.

Table 6. YIELD DATA ON SPRING WHEAT VARIETIES GROWN IN THE SPRING WHEAT VARIETY NURSERY, WYOMING EXPERIMENT STATION, LARAMIE, WYOMING.

Variety	C. I. No.	Yields in bushels per acre (a)							Agronomic and Disease notes (a)				
		1942	1943	1945	1946	1947	1943-46 Av.	wt./bu. 1943-46	Date Headed 1943-46 (July)	% Lodging 1946	% Shattering 1945	% Stem Rust 1943-46	% Leaf Rust 1945-46
Marquis	3,641	32.5	34.4	32.8	49.9		39.0	58	18	56	4	61	90
Thatcher	10,003	31.8	41.4	49.8	74.7	57.4	55.3	61	14	22	1	5	95
Pilot	11,945		42.0	52.2	67.0	55.5	53.7	61	15	56	1	2	54
Regent	11,869		38.8	49.6	52.6		47.0	61	11	16	5	8	90
Renown	11,709		35.1	42.7	64.7		47.5	62	13	12	3	3	95
Merit 3	12,036	27.8	44.8	51.6	60.6		52.3	59	14	26	2	3	73
Rival	11,708		28.1	47.2	57.3		44.2	60	17	57	7	5	65
Reward	8,182		31.4	37.4	58.4		42.4	63	10	20	3	62	90
Komar	8,004		44.5	44.8	70.0		53.1	60	15	81	0	48	76
Henry	12,265			54.5	65.8								
Idaed	11,706	29.9	40.4										
Lemhi	11,415	31.2	44.8	24.2	39.3	7.4	36.1	49	16	42	0	90	75
Hard Federation	4,980	31.1	37.8	24.2	33.9		32.0	47	16	18	1	90	80
Baart No. 38 (b)	11,907	28.4	44.9	54.7	68.9	58.7	56.2	62	13	82	5	33	55
Onas	6,221	33.4	43.3	28.5	45.9		39.2	50	16	40	1	90	77
Dicklow	3,663	32.0	39.6	17.5	27.4		28.2	43	25	64	1	83	100
Mindum (Durum)	5,296			44.8	69.4	71.4							

(a) No crop in 1944—completely destroyed by hail.

(b) In 1942 and '43 yields for Baart, C. I. 1,697 was used.

ACCEPTABLE VARIETIES

Varieties which for various reasons are thought not to be equal to the recommended varieties are included in this group. In some cases it may be that further testing will result in their addition to the recommended list.

Mida (C. I. 12,008) is a bearded, hard red spring wheat, resistant to the rusts and bunt, with good yielding ability, stiff straw, and heavy test weight per bushel, and attractive grain color. However, in tests in Wyoming it has shattered badly when left standing until fully ripe (Table 2). This quality is a fault which might result in serious losses, especially in wheat to be combined. Mida also has been very susceptible to loose smut. In the three years tested at Laramie it has yielded 99 per cent as much as Thatcher (Table 1), and at Sheridan, in the eight years grown, it has been almost equal to Thatcher but has yielded an average of 2.0 bushels per acre less than Pilot. In the cooperative tests (Table 5), it has yielded slightly more than Thatcher but less than Pilot at Gillette. At Archer and Torrington, Mida has a yield advantage over both Thatcher and Pilot for the short period grown.

Mida which was developed by the North Dakota Experiment Station by selection from the cross, (Ceres x Double Cross) x Mercury, was released to farmers of North Dakota in the spring of 1944.

Cadet (C. I. 12,053) is a beardless, attractive, strong-strawed, erect headed variety which is resistant to stem and leaf rusts and about equal in bunt resistance to Thatcher and Marquis.

In the five years that it has been grown at Laramie, it has yielded 0.6 bushel per acre less than Thatcher and has been equal in yield to Pilot during that period. In the seven years of dry-land tests at Sheridan it has yielded 3.6 and 4.3 bushels per acre less than Thatcher and Pilot, respectively. In the cooperative tests (Table 5) Cadet has compared favorably with Thatcher.

Cadet heads three days later than Thatcher at Laramie (Table 2). It has been taller than Thatcher, lodged less than Thatcher (29 per cent to 39 per cent), and is more resistant to stem and leaf rusts. At Sheridan (Table 4), it has headed four days later, ripened two days later, and been three inches taller and two pounds lighter in test weight than Thatcher. It may be that with additional testing Cadet will be added to the recommended varieties to be grown on irrigated land.

A ten-year period of breeding and development was required to produce Cadet. This variety is the final result of a cross made in 1936 by

J. Allen Clark of the U. S. Department of Agriculture, Bureau of Plant Industry, Soils and Agricultural Engineering. It came from a cross of the Merit and Thatcher varieties. Cadet has excellent milling and baking qualities (9).

VARIETIES NOT RECOMMENDED

These varieties are still grown in the state but can be advantageously replaced by the superior varieties available.

Marquis (C. I. 3,641) was undoubtedly the outstanding spring wheat breeding achievement in its time. Literally all varieties of hard red spring wheat which are widely grown at the present time trace back to Marquis as one of the contributors of superior germ plasm. Marquis was the leading spring wheat variety in the United States from 1919 to 1934. It is a selection from a hybrid produced by crossing the old Red Fife variety with a hard red spring wheat from Calcutta, India, in 1882. The selection, which was named Marquis, was selected by Charles E. Saunders and first grown as a pure line at Ottawa, Canada, in 1913.

Because of its early maturity, good quality, and high average yields as compared with varieties of hard red spring wheat then available, Marquis increased rapidly, and for many years previous to 1934 it was the most widely grown variety of that class. Beginning in 1929 the acreage has partly been replaced, first by Ceres, and then by Thatcher (2).

Ceres (C. I. 6900) has had a good record on the dry-land in Wyoming. However, both Thatcher and Pilot have slightly better records and are more resistant to stem rust and to bunt, or stinking smut.

Clark (1) indicates that "Ceres was developed at the North Dakota Agricultural Experiment Station from a cross between Marquis and Kota, made in 1918. The superior characters of Ceres when distributed in 1926, as compared to varieties then available, were moderate resistance to stem-rust, medium maturity, fair strength of straw, high yield, and quality. It was first severely injured by stem-rust in the heavy epidemic of 1935, and its acreage has since steadily given way to Thatcher" in the spring wheat region.

Rival (C. I. 11,708) is an attractive, bearded, hard red spring wheat which is resistant to stem and leaf rust and has given grain of excellent quality. However, Rival has shattered so badly in Wyoming, even before fully ripe, that it was discarded from the advanced plots after 1943 as not promising for Wyoming.

Reward (C. I. 8182) is an extremely early beardless hard red spring wheat which is very susceptible to stem-rust, but because of its early maturity it often escapes damage where other varieties are injured (2). In the three years it has been grown at Laramie (Table 6), it has yielded an average of 12.9 bushels per acre less than Thatcher; in the eight years grown at Sheridan (Table 3), it has averaged 1.3 bushels less than Thatcher.

Reward resulted from a cross of Marquis x Prelude made in 1911 by Charles E. Saunders of the Canadian Department of Agriculture (2).

Newthatch (C. I. 12,318) is a beardless wheat which is similar in appearance to Thatcher. For the limited time tested it has not been quite equal to Thatcher on the average. Since Hope x Thatcher[3], C. I. 12,199 (a sister selection to those selections going into Newthatch), has had a better record in Wyoming than Newthatch (Tables 1 and 5), it would be recommended above Newthatch for our conditions.

Newthatch was developed by the backcross method of breeding at the Minnesota Experiment Station, in which the leaf and stem rust resistance of Hope was added to Thatcher's good agronomic characters and stem-rust resistance. Thatcher was the recurrent parent in the cross Hope x Thatcher[3]. Seven selections from a single F_2 selection from this cross were bulked and later named Newthatch (1).

Supreme (C. I. 8025) is a variety developed in Canada. In the United States it has been raised primarily in Montana. It was tested for three years at the Sheridan station 1935-37 (Table 3), but was outyielded by an average of 2.6 bushels per acre by Thatcher during that period. Supreme is a selection from Red Bobs made by Seager Whealer at Rosthern, Saskatchewan, Canada. It is completely beardless, and is susceptible to stem-rust (2).

Ruby (C. I. 6047) differs from Marquis principally in being five days earlier and in having purple straw. As reported by Hartman (4), Ruby was grown for ten years in Wyoming (1920-29) under irrigation, and in that period of time Marquis outyielded Ruby by an average of 12.1 bushels per acre.

WINTER WHEAT

During the last several years, with the great demand for wheat and as a result of the good crops obtained on dry-land, winter wheat acreage has increased more rapidly than spring wheat until at present approximately

two-thirds of the production of wheat in Wyoming is winter wheat. In 1946 Wyoming produced 4,902,000 bushels of the latter grain.

With the exception of the experimental work which has been under way for a long period at the Sheridan Field Station, there is only a limited amount of data available as to the relative performance of the winter wheats in Wyoming. Some expansion in experimental work has been undertaken since 1943, and at the present time winter wheat variety trials are being conducted at the Sheridan, Gillette, and Archer substations in addition to a nursery raised under irrigation at Laramie. By using the information available from Wyoming experiments and those results published from experiment stations in neighboring states, a reasonable evaluation of varieties now available can be made. The varieties of winter wheat have been divided into three groups, i.e., recommended, acceptable, and not recommended. Some varieties in the latter group, which have not been tested sufficiently in Wyoming, may later be placed in the recommended group, although enough is known about most of these varieties to suggest that such a change will not be likely.

RECOMMENDED VARIETIES

Cheyenne (C. I. 8885) is a bearded hard red winter wheat with short erect heads. It stools heavily and has stiff straw, which makes it a good variety for combine harvesting (6). Cheyenne has been raised at the Sheridan Field Station since 1935. During that period it has had the best average yield record of the winter wheats grown at that station (Table 7). Cheyenne has averaged 2.8 bushels per acre more than Kharkof and 0.8 bushel more than Kanred. The variety, during the six-year period, has had a slight advantage, on the average, over Kharkof and Kanred (Table 8). It has headed at the same date as these two varieties, has been one inch shorter than Kanred, and has had a slightly higher average weight per bushel than Kanred. In the limited tests at Gillette and Archer, Cheyenne has been about equal to Kharkof (Table 9). According to Quisenberry (5), Cheyenne averaged (1931-39) two bushels more than Kharkof, 0.2 bushel per acre more than Nebr. 60, and 1.2 bushels more than Tenmarq at the Box Butte Experiment Farm, Alliance, Nebraska. The station at Alliance is a dry-land farm approximately 100 miles east of Torrington.

According to Quisenberry (6), "Cheyenne is the result of a plant selection made from Crimean (C. I. 1435) in 1922 at the Nebraska Agricultural Experiment Station. The milling behavior of Cheyenne is

Table 7. YIELDS OF WINTER WHEAT VARIETIES GROWN AT THE SHERIDAN FIELD STATION (DRY-LAND)

Variety	C. I. No.	Yields in bushels per acre. 1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	13 yr. Av. 1934-36	12 yr. Av. 1935-46
Kanred	5,146	33.3	23.5	11.0	15.9	44.3	44.3	37.6	34.8	43.7	37.9	17.5	40.0	67.9	34.7	34.9
Kharkof	1,442	31.2	18.0	6.9	15.6	44.4	41.6	37.0	36.4	42.2	37.4	18.3	38.2	58.4	32.7	32.9
Minturki	6,155	26.3	23.2	6.5	14.1	41.9	40.0	31.5	33.3	35.8	47.7	12.2	26.6	55.3	30.3	30.7
Karmont	6,700	31.5	19.9	9.3	11.6	42.8	37.3	33.0	38.2	41.6	36.4	19.6	31.8	56.0	31.5	31.5
Yogo	8,033	29.0	19.6	10.7	20.8	42.5	36.4	33.6	37.9	35.5	45.5	16.2	32.2	62.9	32.5	32.8
Turkey	10,016	28.7	19.9	9.0	12.8	43.4	43.7									100%(a)
Nebr. No. 60	6,250	29.3	18.0	11.0	17.7	46.4	46.8	35.8	35.5	38.5						102%(a)
Mont. 36	5,549	31.5	18.6	11.3	15.0	45.8	39.4	35.7	38.2	40.9						101%(a)
Cheyenne	8,885		27.5	8.5	17.1	44.6	52.3	34.7	34.5	44.8	39.4	18.3	35.8	69.5		35.7
Marmin	11,502			7.6	14.7	40.4	37.9	33.0	36.7	36.7	41.9	13.4	37.1	49.5		93%(a)
Nebred	10,094				13.4	44.9	44.9	37.6	36.4	41.6	44.0	18.0	25.0	60.5		99%(a)
Mont. 36—Belog. x Kan.	12,108									41.3	43.1	15.6	34.2	61.1		100%(a)
Minter	12,138												28.4	59.3		91%(a)

(a) Per cent of Kharkof for years grown. Kharkof yields = 100%.

similar to that of Turkey, but because of high yield this variety may be a little lower in protein content than some others. For the best results in baking, the dough must be mixed longer than for other varieties."

Nebred (C. I. 10,094) as described by Quisenberry (6) is a bearded hard red winter wheat with smooth white glumes and in appearance is very similar to Turkey. It is slightly more winter hardy than Cheyenne and Turkey and on the average matures about one day earlier than Cheyenne. The straw is not so stiff as that of Cheyenne. Nebred is less susceptible to stem-rust than Cheyenne or Kharkof, and it seems able to produce a relatively good crop of grain under a rather heavy stem-rust epidemic. The variety is highly resistant to many forms of bunt or stinking smut.

Nebred was selected from Turkey (S. Dak. 144) in 1924 at the Nebraska Experiment Station.

This variety has been about equal in yield to Kharkof at Sheridan (99 per cent) (Table 7), slightly better in yield in the short test period at Gillette and Archer, and slightly ahead of Kharkof for the two years 1938-39 reported at Alliance, Nebraska. Cheyenne has had a better yield record than Nebred at Sheridan and Alliance.

ACCEPTABLE VARIETIES

These are varieties whose average performance has not equalled that of the varieties recommended.

Yogo (C. I. 8033), a hard red winter wheat, has been one of the most winter hardy of the wheats grown in Wyoming. Where winterkilling is often a factor in winter wheat production, Yogo may be satisfactory. However, its average yield performance has not been equal to that of Cheyenne or of Nebred at the Sheridan Field Station (Table 7).

Yogo is a tall wheat with long, lax, nodding spikes. There has been some suggestion that this wheat is a little difficult to thresh with a combine in that the grain is not readily knocked from the head. The variety is resistant to many races of bunt. It resulted from the cross, (Minturki x Beloglina) x Buffum, made in 1919 at Manhattan, Kansas. Head selections made from this cross at the Judith Basin Branch Station, Moccasin, Montana, in 1923 resulted in Yogo.

Kanred (C. I. 5146) has had a relatively good record in Wyoming (Table 7) but might well be replaced by one of the recommended varieties. Kanred's principal faults are low test weight and weak straw, which may cause lodging in some years.

Kanred is a selection from Crimean made at the Kansas Agricultural Experiment Station (6).

Nebr. No. 60 (C. I. 6250) for the eight year period 1935-42 averaged 1.9 bushels per acre less than Cheyenne at the Sheridan Field Station (Table 7). The variety was selected from Turkey in 1908 at the Nebraska Station, according to Quisenberry (6). It differs from Turkey chiefly in being more winter hardy and slightly later in ripening.

Turkey or Kharkof (C. I. 1442) is a name applied to a large group of rather similar wheats. Usually if a winter wheat has a bearded head, white chaff, and hard red grain, it is called Turkey. Wheats such as Kharkof, Malakof, and Crimean are of this general type and differ chiefly in their point of origin in Russia and time of importation into this country (6). Kharkof has been used as the "check" variety in all the winter wheat tests in Wyoming. While it has a good record (Table 7), it has not been equal to Cheyenne in tests of long duration in the state.

NOT RECOMMENDED

This group includes those varieties thought to be not as well adapted in Wyoming as the recommended varieties.

Pawnee (C. I. 11,669), according to Reitz (7), has certain advantages. It is moderately resistant to hessian fly, leaf rust, stem-rust, and

Table 8. AGRONOMIC DATA OF WINTER WHEAT VARIETIES GROWN AT THE SHERIDAN FIELD STATION FROM 1937 TO 1942.

Variety	C. I. No.	Av. % Survival	Av. Date Headed (July)	Av. Plant Ht. (Inches)	Av. Wt. Per Bu. (lbs.)
Kanred	5,146	86	13	41	59.2
Kharkof	1,442	86	13	40	59.2
Minturki	6,155	86	14	42	58.6
Karmont	6,700	86	13	41	59.0
Yogo	8,033	86	15	42	59.0
Cheyenne	8,885	88	13	40	60.0
Nebred	10,094	85	12	38	59.4

bunt. It has high resistance to loose smut, and it has short stiff straw. However, the variety is only moderately winter hardy, is susceptible to speckled leaf blotch (Septoria), and may shatter more than Tenmarq.

In Nebr. Bul. 367 (6) is found this statement:

"In cooperative tests on farms, Pawnee has outyielded the standard varieties in the Southeastern District by a wide margin, but farther west the difference becomes less, until in the Northwestern and Southwestern

Table 9. YIELDS OF WINTER WHEAT VARIETIES GROWN COOPERATIVELY WITH THE SUBSTATIONS

Variety	C. I. No.	Gillette Bushels per acre				Archer Bushels per acre			
		1944	1945	1946	1947	1944	1945	1946	1947
Tenmarq	6,936		55.1	35.8					
Cheyenne	8,885	30.2	51.4	40.4	22.1	7.7			41.8
Kharkof	1,442	26.3	55.4	46.5	26.1	10.1			40.6
Nebred	10,094	32.3	56.9	35.5	19.0	13.8			40.0
Yogo	8,033	30.0	49.8	36.7	23.5	13.7			37.6
Blackhull	6,251	28.9	51.1	33.9	22.6	17.6			43.7
Kanred x Minhardi	11,726	30.9	49.1	42.5	21.2	5.0			45.1
Mont. 36—Belog x Kanred	12,108	28.0	53.6	41.9	21.4	11.4			44.9
Cheyenne x Turkey	12,142	29.5	54.3	35.6	23.4	15.3			45.5
Turkey x Turkey — Cheyenne Nebr. 383130		34.1	51.3	37.3	17.7	13.8			43.1
Cheyenne x Tenmarq	11,972			43.7	19.3				42.6
Cheyenne x Hungarian Sel. Nebr. 403858				39.7	21.2				41.4
Wichita	11,952		45.6	38.8	21.2				39.0
Cheyenne x Early Blackhull	12,122			38.0	17.6				42.4
Hungarian Sel. x Nebred Nebr. Sel. 405404				37.3	18.9				43.1
Comanche	11,673		50.4	34.9	13.6				36.2
Minturki	6,155	29.2	51.5			12.8			
Nebr. No. 60	6,250	30.1	52.8			10.2			
Least difference for significance (a)		4.2	4.8	9.3		3.7			

(a) A difference exceeding that shown could occur by chance alone only once in 20 trials.

Districts Pawnee is outyielded by Cheyenne and Nebred. Based on this yield information, the seed supply of Pawnee has been increased for distribution and is recommended for the Southeastern District of Nebraska. The variety has a slight tendency to shatter when ripe, but is not so bad as Kawvale or Iobred in this respect. Pawnee is slightly more winter hardy than Tenmarq and Blackhull."

In 1942-43 the winter wheat at Laramie suffered some winter killing. Pawnee had a survival rate of 41.7 per cent, compared to 75 per cent survival for Yogo, 52 per cent for Nebred, and 47.4 per cent for Cheyenne. Pawnee's performance in the Wyoming portion of the Great Plains has been variable, ranging from very good to mediocre. In tests at Laramie it has shattered badly. The above facts are cited because they have contributed to our decision not to recommend Pawnee until more information is available.

Pawnee resulted from a Kawvale x Tenmarq Cross.

Tenmarq (C. I. 6936) is early and has fair straw strength. It is rather winter tender but yields well in the absence of winter killing. Tenmarq was produced from a hybrid between Marquis (spring wheat) and P-1066 (sister selection of Kanred) at the Kansas Agricultural Experiment Station (6).

Blackhull (C. I. 6251) is distinctly less winter hardy than Turkey wheat. It is a few days earlier and has a softer kernel. The glumes of Blackhull usually have black stripes or sometimes are almost entirely black.

Blackhull was originated by Earl G. Clark, a farmer of Sedgwick, Kansas, as a selection from a field of Turkey (3).

Comanche (C. I. 11,673) is a new variety, selected from an Oro x Tenmarq cross, released in Kansas in 1942. It is bearded, early ripening, moderately winter-hardy, and it has fairly good straw. It is resistant to many forms of bunt, and has some resistance to stem and leaf rusts. It is susceptible to loose smut (7).

Comanche's yield record during the very limited time that it has been tested in Wyoming (Table 9) has been less than that of Cheyenne.

Wichita (C. I. 11,952) is an extremely early variety selected from the cross, Early Blackhull x Tenmarq. It is very winter tender and has a weak straw (6). The yields so far in Wyoming (Table 9) have been lower than Cheyenne.

SUMMARY

1. The older varieties, such as Marquis and Ceres spring wheats and Turkey and Kanred winter wheats, are still widely grown in Wyoming. These should be replaced with the improved varieties available. Greater returns per acre will result to the growers making such changes.

2. The following spring wheat varieties are recommended.
   a. *Thatcher* is recommended for both irrigated and dry-land conditions. It is beardless and resistant to stem-rust and has relatively strong straw and good yield.
   b. *Pilot* is primarily recommended for dry-land. It is bearded, it is resistant to stem and leaf rust and to bunt, and it gives a high yield.
   c. *Onas* is a soft white wheat recommended to those growers of wheat for feed where stem-rust is not a factor in production. It has a short stiff straw, is beardless and has high yielding ability. Seed should be treated to prevent bunt, or stinking smut.
3. The following winter wheat varieties are recommended.
   a. *Cheyenne* has stiff straw and short erect heads, stools heavily, and is high yielding.
   b. *Nebred* is similar to Turkey in appearance, but slightly more winter hardy. It is resistant to many races of bunt and somewhat tolerant of stem-rust.

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J. A. HILL, B.S., Wool Specialist.
ROBERT H. BURNS, Ph.D., Wool Specialist.
ALEXANDER JOHNSTON, M.S., Assoc. Wool Specialist.
LAWRENCE C. PARKER, M.S., Research Asst.
DONALD JOHNSTON, M.S., Research Asst.

Zoology:

JOHN W. SCOTT, Ph.D., Zoologist and Parasitologist. (limited service).
RALPH HONESS, M.A., Asst. Research Zoologist.

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